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ROUND-ROBIN STUDY OF SUBSTITUTE MATERIALS FOR NBS  
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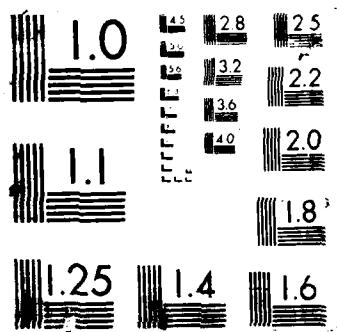
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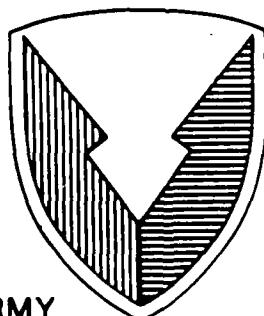
TE 42-87

APRIL 1988

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ROUND-ROBIN STUDY OF  
SUBSTITUTE MATERIALS FOR  
NBS 1810 LINERBOARD

PREPARED BY:



US ARMY  
MATERIEL COMMAND

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PACKAGING, STORAGE, AND  
CONTAINERIZATION CENTER

TOBYHANNA, PENNSYLVANIA 18466-5097

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## ABSTRACT

The U.S. Army Materiel Command Packaging, Storage and Containerization Center participated in a mini round-robin study to determine if Mosinee 696-C paper is a viable substitute for National Bureau of Standards (NBS) reference material No. 1810 standard linerboard. This study was sponsored by the American Society for Testing and Materials (ASTM) under the jurisdiction of Committee D10 on Packaging. Three stress tests were conducted on 16 rolls of pressure-sensitive tapes using ASTM D 2860-83, Adhesion of Pressure-Sensitive Tape to Fiberboard at 90° Angle and Constant Stress; ASTM D 3654-82, Method A-Holding Power of Pressure-Sensitive Tapes; and ASTM D 3654-82, Method B-Holding Power of Pressure-Sensitive Tapes. The tapes tested were film backing pressure-sensitive tapes conforming to PPP-T-60, type III, classes 1 and 2; paper backing pressure-sensitive tapes conforming to PPP-T-76; and filament reinforced tapes conforming to PPP-T-97. All tests were run at a standard temperature and humidity of 73° F. and 50 percent, respectively. The results obtained on the Mosinee 696-C demonstrated that this paper showed equivalent if not better performance than that of the NBS-1810 standard linerboard.

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U.S. ARMY MATERIEL COMMAND  
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ROUND-ROBIN STUDY OF SUBSTITUTE MATERIALS  
FOR NBS-1810 LINERBOARD

AMCPSCC Assignment Report TE 42-87

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April 1988

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1. Introduction. One of the recommendations set forth in Assignment Report TE 32-86 was that, in light of the fact that NBS-1810 is no longer being manufactured, Mosinee No. 767-B be used by the Engineering and Laboratory (E&L) Division in testing the adhesion properties of pressure-sensitive tapes.<sup>1</sup> ASTM became interested in the problem of finding a substitute material for NBS No. 1810 standard linerboard. A task group was formed and represented laboratories were asked to participate. The interested laboratories involved in this study were 3M's Packaging Systems Division Laboratory and the Engineering and Testing (E&T) Branch, E&L Division of AMCPSCC. The papers chosen were Mosinee Nos. 767-B, 789-B, and 696-C papers. Mosinee 696-C paper was chosen as the material to be evaluated in this mini round-robin study. This paper is lighter in weight than either the Mosinee 767-B or 789-B papers and the supplies of this paper were assured by the manufacturer. The results of the AMCPSCC study will be presented in this report.

2. Discussion. a. Materials used in test.

(1) Tapes. The 3M Company supplied E&T Branch with 16 rolls of tape. They were from the same sample lots used by 3M's laboratories to complete their testing. These tapes are listed in table 1:

Table 1. Identification of Rolls of Tape Tested

<u>TAPE NO</u>	<u>TYPE</u>	<u>SPECIFICATION</u>
1	Scotch "898"(1 1/2")-#5057	PPP-T-97
2	Scotch "898"(2")-#5076	PPP-T-97
3	Scotch "260"(2")-#5331-4W6-116	PPP-T-76
4	Scotch "260"(2")-#6330	PPP-T-76
5	Scotch "260"(2")-#6353	PPP-T-76
6	Scotch "260"(2")-#6354	PPP-T-76
7	Scotch "260"(2")-#701	PPP-T-76
8	Scotch "355"(1"), Trans.	PPP-T-60
9	Scotch "355"(2"), Trans.-#5288-1W1-293	PPP-T-60
10	Scotch "355"(3"), Trans.-#2-6052-2W6-297	PPP-T-60
11	Scotch "355"(1 1/2"), Trans.-#2-6153-8W6-219	PPP-T-60
12	Scotch "355"(2"), Trans.-#2-6171-14W6-307	PPP-T-60
13	Scotch "355"(2"), Opaque-#5171	PPP-T-60
14	Scotch "355"(2"), Opaque-#6289	PPP-T-60
15	Scotch "355"(2"), Opaque-#6309	PPP-T-60
16	Scotch "355"(2"), Opaque-#6350	PPP-T-60

(2) Linerboard. The standard linerboard used in lieu of NBS-1810 standard linerboard was Mosinee 696-C paper, 60 - 63# Bs. Wt., Caliper .005, medium frequency converting (neutral pH). Existing stocks of NBS-1810 were also used as a comparison with Mosinee 696-C.

b. Conditioning of test materials.

(1) The test materials were subjected to a standard atmosphere of  $73.4^{\circ}$  F.  $\pm 1.8^{\circ}$  F. ( $23^{\circ}$  C.  $\pm 1^{\circ}$  C.) and 50 percent  $\pm$  2 percent relative humidity (RH) for at least 24 hours prior to testing. Conditioning was in accordance with ASTM D 685-73.

(2) All tests were run at the same standard conditions.

c. Tests performed.

(1) ASTM D 2860-83, Procedure B - Adhesion of Pressure-Sensitive Tape to Fiberboard at  $90^{\circ}$  Angle and Constant Stress. In this procedure, the standard linerboard representing the fiberboard is adhered to a rigid panel and the time required for the tape to peel away from the standard linerboard is recorded. A mass of  $200 \pm 0.2$  g is attached to the tape to provide the constant stress required for this test. All tapes tested were subjected to the above procedure.<sup>2</sup>

(2) ASTM D 3654-82, Procedure A - Holding Power of Pressure-Sensitive Tapes. In this procedure, a standard area of tape is applied to the standard linerboard, which is adhered to a rigid panel, at a  $180^{\circ}$  angle. A standard mass of  $1000 \pm 5$  g is attached to the tape and the time required for the tape to fail is recorded. Tape Nos. 3 through 16 were tested by this procedure.<sup>3</sup>

(3) ASTM D 3654-82, Procedure B - Holding Power of Pressure-Sensitive Tapes. In this procedure, a standard area of filament reinforced tape is applied to the standard linerboard which is adhered to a rigid panel. The tape is then positioned at a  $90^{\circ}$  angle to the panel and a 10-pound mass is attached to the tape. The amount of slippage is then measured at the end of a 48-hour period and recorded. This test is only used to measure the holding power of filament reinforced tape. Tape Nos. 1 and 2 were tested by this procedure.<sup>3</sup>

d. Discussion of test results.

(1) ASTM D 2860-83, Procedure B - Adhesion of Pressure-Sensitive Tape to Fiberboard at  $90^{\circ}$  Angle and Constant Stress. Ten samples were cut from each roll of tape. Five samples were run using NBS-1810 standard linerboard and five samples were run using Mosinee 696-C paper as the standard linerboard.

The average time, required for failure, was recorded and the results presented in table 2:

Table 2. ASTM D2860-83, Adhesion of Pressure-Sensitive Tape to Fiberboard at 90° Angle and Constant Stress

TAPE NO.	AVERAGE TIME TO DROP (MIN)	
	NBS-1810	MOSINEE 696-C
1	1508	5274
2	5026	5760
3	916	1908
4	1908	1796
5	1954	2933
6	2415	3241
7	2317	2939
8	413	454
9	1991	1858
10	2545	4635
11	678	779
12	388	462
13	1535	2309
14	1982	3795
15	1212	2719
16	1592	2974

As can be seen from the above results, the Mosinee 696-C paper showed equivalent or better performance than that of the NBS-1810 standard linerboard.

(2) ASTM D3654-82, Procedure A - Holding Power of Pressure-Sensitive Tapes. Ten samples were cut from each roll of tape tested. Five samples were tested using NBS-1810 standard linerboard and five samples were tested using Mosinee 696-C paper. The average time, required for failure, was recorded and the results presented in table 3:

Table 3. ASTM D 3654-82, Holding Power of Pressure-Sensitive Tapes

TAPE NO.	AVERAGE TIME TO DROP (MIN)	
	NBS-1810	MOSINEE 696-C
3	1748	2441
4	1577	2336
5	1557	1559
6	4702	8540
7	7417	9022
8	3834	6365
9	5161	5835
10	4132	7518
11	4153	9422
12	2090	5107
13	3508	4694
14	3533	6307
15	3802	7187
16	8555	9412

As can be seen from the above results, the Mosinee 696-C paper also showed equivalent if not better performance than the NBS-1810 standard linerboard. These results further confirm that the Mosinee 696-C paper is a viable substitute for NBS-1810 standard linerboard.

(3) ASTM D 3654-82, Procedure B - Holding Power of Pressure-Sensitive Tapes. Ten samples were cut from each of two rolls of filament reinforced tape. Five samples were tested using the NBS-1810 standard linerboard and five samples were tested using Mosinee 696-C paper. The average slippage in a 48-hour period was then recorded. These results are shown in table 4:

Table 4. ASTM D 3654-82, Holding Power of Pressure-Sensitive Tapes

TAPE NO.	AVERAGE SLIPPAGE (IN/48 HRS)	
	NBS-1810	MOSINEE 696-C
1	3/32	3/32
2	1/16	1/16

As can be seen from the above test results, the Mosinee 696-C showed equivalent performance with that of the NBS-1810 standard linerboard. This again confirms that Mosinee 696-C paper is a viable substitute for the NBS-1810 standard linerboard.

3. Conclusions. a. For all three tests, it can be concluded that the Mosinee 696-C paper showed equivalent if not better performance than the NBS-1810 standard linerboard. The results of each of the tests performed support this conclusion.

b. Mosinee 696-C paper can be used as a viable substitute for NBS-1810 standard linerboard, assuming proper and strict quality control measures are followed throughout the manufacturing process.

4. Recommendations. a. Due to the fact that NBS-1810 standard linerboard is no longer manufactured, it is recommended that both ASTM and NBS adopt Mosinee 696-C paper as the standard linerboard used in testing the adhesion and holding power of pressure-sensitive tapes.

b. That ASTM take whatever steps are necessary to promote the use of this paper in their methods.

Bibliography

<sup>1</sup>Baroody, S. and Stefonetti, C., Evaluation of Potential Replacement for National Bureau of Standards Reference Material No. 1810 Linerboard, AMCPSCC Assignment Report TE 32-86, September, 1986.

<sup>2</sup>American Society of Testing and Materials, 1987 Annual Book of ASTM Standards, Vol. 15.09, pp. 414-419.

<sup>3</sup>American Society of Testing and Materials, 1987 Annual Book of ASTM Standards, Vol. 15.09, pp. 639-642.

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